Publication number : 2002-236292

Date of publication of application : 23.08.2002

Int.Cl. G02F 1/1339 G02F 1/13 G02F 1/1333

Application number : 2001-033575

Applicant : MATSUSHITA ELECTRIC IND CO LTD

Date of filing : 09.02.2001

Inventor :

SUMIDA SHIROU

YAMADA SATOSHI

MATSUKAWA HIDEKI

MANUFACTURING METHOD FOR LIQUID CRYSTAL PANEL AND SUBSTRATE STICKING DEVICE

[Abstract]

PROBLEM TO BE SOLVED: To provide a manufacturing method for a liquid crystal panel, by which manufacturing stages can be simplified and to provide a substrate sticking device used for the method.

SOLUTION: In a substrate sticking stage, a lower substrate 4 is attracted to a lower surface plate 2 through an elastic body 5 in which attracting holes 51 are formed with a pitch 52 which is integral multiple of a pitch 22 of an attracting grooves 21 of the lower surface plate 2. After the positioning of an upper and a lower substrates 3 and 4 is performed, the substrates are stuck to each other by

pressing the substrates through an upper surface plate 1 and the lower surface plate 2 to crush a sealing resin 6. Even if the surface working precision of the upper and the lower surface plates 1 and 2 is insufficient, sticking and uniform pressing of the upper and the lower substrates 3 and 4 can be simultaneously performed and a pressing stage for crushing the sealing resin, which has been conventionally needed after the substrate sticking stage, is not required and the manufacturing stages can be simplified.

【Claims】

【Claim 1】 A method for manufacturing a liquid crystal panel, comprising the steps of: applying sealing materials for attaching a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; attaching the substrates by way of pressing the sealing materials through vacuum absorbing any one substrate from the pair of substrates using a substrate attaching apparatus, which includes an upper base plate and a lower base plate, to an absorption surface provided with an absorption groove or absorption opening for the lower base plate via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with vacuum absorbing the other substrate to an absorption surface of the upper base plate, and pressurizing the pair of substrates via the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with regard to the substrate attaching process, and the pitch is n times or 1/n times the pitch of the absorption groove or opening in the lower base plate, whereby n is an integral number.

【Claim 2】 A method for manufacturing a liquid crystal panel, comprising the steps of: applying sealing materials for attaching a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; dropping desired amounts of liquid crystal materials on any one substrate from the pair of substrates; attaching the substrates by way of pressing

the sealing materials through vacuum absorbing any one substrate, on which the liquid crystal materials are dropped, from the pair of substrates using a substrate attaching apparatus, which includes an upper base plate and a lower base plate in a chamber, to an absorption surface provided with an absorption groove or absorption opening for the lower base plate, via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with maintaining the vacuum degree of the chamber lower than the vacuum absorption power of the substrate in the chamber, and pressurizing the pair of substrates with interposing the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with regard to the substrate sticking process, and the pitch is n times or 1/n times a pitch of the absorption groove or opening in the lower base plate, whereby n is an integral number.

【Claim 3】 The method of Claim 2, wherein the vacuum degree of the vacuum absorption of the substrate formed by the upper and lower base plates in the substrate attaching process, is maintained below 0.1 $\times 1.33322 \times 10^2$ Pa, and the vacuum degree of the vacuum chamber is maintained from 0.5 $\times 1.33322 \times 10^2$ Pa to $1.0 \times 1.33322 \times 10^2$ Pa.

【Claim 4】 An Apparatus for attaching substrates, wherein the apparatus includes an upper and lower base plates provided with an absorption groove or opening at respective absorption surfaces of the substrates, a pair of substrates are absorbed to the upper and lower base plates so as to be maintained at

predetermined intervals thereby enabling position alignment, the pair of substrates can be pressurized via the upper and lower base plates between the substrates, an elastic body with an absorption opening is arranged incidentally to an absorption surface of the lower base plate, and a pitch of the absorption opening in the elastic body is n times or 1/n times a pitch of the absorption groove or opening of the lower base plate, whereby n is an integral number.

【Claim 5】 The Apparatus of Claim 4, wherein the upper base plate and the lower base plate provided with the elastic body are arranged in the chamber, in which an inner pressure can be adjusted.

[Title of the invention]

MANUFACTURING METHOD FOR LIQUID CRYSTAL PANEL AND SUBSTRATE STICKING DEVICE

【Detailed Description of the Invention】

【001】

【Field of the Invention】

The present invention relates to a method for manufacturing a liquid crystal panel and apparatus for sticking substrates using same.

【002】

【Description of the Prior Art】 FIG. 3 shows a conventional schematic cross-sectional view of a sticking process in a manufacturing method for a liquid crystal panel. As shown in FIG. 3, in the conventional liquid crystal manufacturing process, sticking was performed after upper and lower substrates 3, 4 had been stuck directly in a vacuum circumstance on upper and lower base plates 1,2 to thereby align the upper and lower substrates 3, 4.

【003】

【Problems to be solved by the Invention】 Although the degree of precision in cell gaps required for the liquid crystal panel is below ±0.3 ㎛ for TN panel, and below ±0.05 ㎛ for STN panel, the planar machining degree of precision of the upper and lower metallic base plates 1, 2 with regard to the above precision degree can not be expected more than ±20 ㎛. Accordingly, in the conventional sticking process of the substrates, it is impossible to press upper and lower substrates 3, 4 uniformly, and it is necessary to press the upper and lower substrates 3, 4 using separately prepared press after the above sticking process,

and to press sealing resins to a desired amounts, in order to obtain required degree of precision of the cell gaps. Thus, separate pressing process has been required to press sealing resins 6 after the conventional sticking process of the substrates.

【004】 The object of the present invention is to provide a method for manufacturing a liquid crystal panel, in which simplification of the manufacturing process can be achieved, and an apparatus for sticking substrates using same.

【005】

【Means for Solving the Problem】 According to the method for manufacturing a liquid crystal panel described in claim 1, the method is characterized by comprising the steps of: applying sealing materials for sticking a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; sticking the substrates by way of pressing the sealing materials through vacuum absorbing any one substrate from the pair of substrates using a substrate sticking apparatus, which includes upper base plate and lower base plate, to an absorption surface provided with absorption groove or absorption opening for the lower base plate, via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with vacuum absorbing the other substrate to an absorption surface of the upper base plate, and pressurizing the pair of substrates with interposing the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with

regard to the substrate sticking process, and the pitch is n(n is a integral number) times or 1/n times a pitch of the absorption groove or opening in the lower base plate.

【006】 According to the manufacturing method of claim 1, the substrate sticking process is carried out by absorbing any one substrate to the lower base plate via the elastic body on which absorption opening is formed, and performing position alignment, and then pressing and sticking sealing materials between the pair of substrates. Although the planar machining degree of the upper and lower base plates is not sufficient, it is possible to pressurize them equally with sticking the pair of substrates simultaneously to thereby remove the pressurizing process for press the necessary sealing materials after the conventional substrate sticking process, and achieve simplification of the manufacturing process. In addition, as the pitch of the absorption opening in the elastic body is made to be n(n is a integral number) times or 1/n times the pitch of the absorption groove or opening in the lower base plate to thereby suppress pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate, and accomplish liquid crystal panel with equal cell gaps.

【007】 According to the method for manufacturing a liquid crystal panel described in claim 2, the method is characterized by comprising the steps of: applying sealing materials for sticking a pair of substrates on any one substrate of the pair of substrates and sealing the liquid crystal into the pair of substrates; dropping desired amounts of liquid crystal materials on any one substrate from the pair of substrates; sticking the substrates by way of pressing the sealing

materials through vacuum absorbing any one substrate, on which the liquid crystal materials are dropped, from the pair of substrates using a substrate sticking apparatus, which includes upper base plate and lower base plate in a chamber, to an absorption surface provided with absorption groove or absorption opening for the lower base plate, via an elastic body having absorption opening between the substrates, and opposing and aligning the pair of substrates with maintaining the vacuum degree of the chamber lower than the vacuum absorption force of the substrate in the chamber, and pressurizing the pair of substrates via the upper and lower base plates between the substrates; wherein a pitch of the absorption opening in the elastic body suppresses pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate with regard to the substrate sticking process, and the pitch is n(n is a integral number) times or 1/n times a pitch of the absorption groove or opening in the lower base plate.

【008】 According to the manufacturing method of claim 2, the substrate sticking process is carried out by absorbing any one substrate to the lower base plate via the elastic body on which absorption opening is formed, and performing position alignment, and then pressing and sticking sealing materials between the pair of substrates. Although the planar machining degree of the upper and lower base plates is not sufficient, it is possible to pressurize them equally with sticking the pair of substrates simultaneously to thereby remove the pressurizing process for press the necessary sealing materials after the conventional substrate sticking process, and achieve simplification of the manufacturing process. In addition, as

the pitch of the absorption opening in the elastic body is made to be n(n is a integral number) times or 1/n times the pitch of the absorption groove or opening in the lower base plate to thereby suppress pressurization inequality of the pair of substrates resulted from the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body and the absorption groove or opening of the lower base plate, and accomplish liquid crystal panel with equal cell gaps.

【009】 According to the manufacturing method of the liquid crystal panel described in claim 3, the vacuum degree of the vacuum absorption of the substrate formed by the upper and lower base plates in the substrate sticking process, is preferable to be maintained below 0.1 $\times 1.33322 \times 10^2$ Pa, and the vacuum degree of the vacuum chamber is preferable to be maintained from 0.5 $\times 1.33322 \times 10^2$ Pa to $1.0 \times 1.33322 \times 10^2$ Pa.

【0010】 According to the apparatus for sticking substrates described in claim 4, the apparatus includes an upper and lower base plates provided with absorption groove or opening at respective absorption surfaces of the substrates, a pair of substrates are absorbed to the upper and lower base plates so as to be maintained at predetermined intervals thereby enabling position alignment, the pair of substrates can be pressurized via the upper and lower base plates between the substrates, incidentally an elastic body with an absorption opening is arranged to an absorption surface of the lower base plate, and a pitch of the absorption opening in the elastic body is n (n is integral number) times or 1/n times a pitch of the absorption groove or opening of the lower base plate.

【0011】 By using the substrate sticking apparatus described in claim 4, it is possible to perform the substrate sticking process of claim 1 to thereby obtain simplification of the manufacturing process.

【0012】 According to the apparatus described in claim 5, the upper base plate and the lower base plate provided with the elastic body are arranged in the chamber, in which inner pressure can be adjusted.

【0013】 By using the substrate sticking apparatus described in claim 5, it is possible to perform the substrate sticking process of claim 2 or claim 3 to thereby obtain simplification of the manufacturing process.

【0014】

【Embodiment of the Invention】 The preferred embodiment of the present invention will now be explained with reference to the appended drawings. FIG. 1 is a schematic view showing substrates sticking process in a method for manufacturing a liquid crystal panel according to first embodiment of the present invention, wherein FIG.1(a) is a cross-sectional view, FIG. 1(b) is a planar view of the elastic body 5, and FIG. 1(c) is a planar view of a base plate 1. FIG. 2 is a schematic view showing sticking process of substrate in a method for manufacturing a liquid crystal panel according to the present invention. Further, FIG. 1 shows a case in which the filling of liquid crystal is performed by vacuum injection method, FIG. 2 shows a case in which it is performed by dropping of the liquid crystal.

【0015】 Hereinafter, seven pairs of amorphous silicon TFT liquid crystal panels are manufactured for tests, with changing the manufacturing conditions, and comparisons are carried out.

【0016】 First, seven pairs of TFT array substrate and color substrate, in which a panel having a size of 300 ㎜ ×400 ㎜ and 10. 4 inches is subjected to patterning on two surfaces, have been prepared, and cleaning, forming alignment film made of polyimide on the respective substrate, hardening, and desired rubbing have been performed.

【0017】 Next, spacer particles 7 made of resins and having particle diameter of 4.5 ㎛ has been applied on the array substrate at a ratio of 100 ~ 200 per ㎟, and ultra violet ray hardening type sealing resins 6, in which 2.0% glass fiber having a fiber length of 5.5 ㎛ is mixed, are formed on a color filter by using screen printing. In this instance, patterns with injection opening have been formed on the first to fourth pairs of color filter substrates, and patterns without injection opening have been formed on the fifth to seventh pairs of the color filter substrates.

【0018】 Sticking process has been carried out using the above seven pairs of array substrates and the color filter substrates as below.

【0019】 First of all, initial pair of substrates has been stuck by conventional manufacturing method. As shown in FIG. 3, the color filter substrate has been absorbed to a lower base plate 2 as lower substrate 4, and the array substrate has been absorbed to the upper base plate 1 as upper substrate 3, then the upper and lower substrates 3, 4 are maintained at a predetermined intervals to align them, and then they have been stuck to each other.

【0020】 Next, the stuck substrates have been withdrawn from the substrate sticking apparatus, and the sealing resins have been pressed by performing vacuum pack(pressurizing process), and then the sealing resins have been hardened by radiation of the ultra violet rays.

【0021】 As shown in FIG. 1(a), those substrates selected from the second pair of color filter substrates to the fourth color filter substrates have been stuck through inserting elastic body 5 between the lower base plate 2 of the substrate sticking apparatus and the lower substrate 4. In this instance, the elastic body made of silicon rubber has a thickness of 1.2 ㎜, and the pitch 52 of an absorption hole 51 thereof shown in FIG. 1(b) is 6 ㎜, 10 ㎜, 24 ㎜ respectively. Further, a pitch 22 of an absorption groove 21 formed at lower base plate 2 was 12 ㎜. Detailed description thereof will be made below.

【0022】 The color filter substrate is vacuum absorbed on the lower base plate 2 as the lower substrate 4 via the elastic body 5, and the array substrate is vacuum absorbed on the upper base plate 1 as the upper substrate 3, and then maintain the upper and lower substrates 3, 4 at a predetermined distance to thereby align the positions thereof, and the sealing resins 6 were pressed sufficiently with the force of 1.5 tons after sticking the upper and lower substrates 3, 4 via the upper and lower base plates 1, 2. In this instance, it is necessary to form an absorption hole 51 at the elastic body 5, which is provided between the lower base plate 2 and the lower substrate 4, so that the upper and lower substrates 3, 4 can be maintained to its aligned position and the upper and lower base plates 1, 2 can be fixed by vacuum absorption. The pitches 52 of the absorption holes 51 formed at the elastic body 5, which have been utilized in the process of assembling the second, third, and fourth color filter substrates, were respectively 10 ㎜, 6 ㎜, and 24 ㎜.

【0023】 Next, the stuck substrates (from the second to the fourth pair of substrates) were withdrawn from the sticking apparatus, and then the sealing resins 6 were hardened by radiation of the ultra violet rays.

【0024】 Then, periphery portions of the above stuck substrates were sheared, and liquid crystal materials were filled by employing vacuum injection method, and then the injection opening were sealed to thereby manufacture a liquid crystal panel.

【0025】 Further, as shown in FIG. 2, the substrates selected from the fifth pair to the seventh pair were stuck, as were in the case of sticking the substrates selected from the second to fourth pair of substrates, via the elastic body 5 inserted between the lower base plate 2 of the substrate sticking apparatus and the lower substrate 4, after dropping liquid crystal materials 8 on the color filter substrate as water drops. Detailed description thereof will be made below. Also, the elastic body 5 and the lower base plate 2 shown in FIG. 2 are illustrated in FIGs. 1(b) and 1(c) in planar view.

【0026】 The color filter substrate on which liquid crystal materials 8 have been dropped as water drops, is vacuum absorbed on the lower base plate 2 as the lower substrate 4 via the elastic body 5, and the array substrate is vacuum absorbed on the upper base plate 1 as the upper substrate 3, then vacuum absorption has been performed in a vacuum chamber 9 to form vacuum having vacuum degree of from $0.5 \times 1.33322 \times 10^2$ Pa to $1.0 \times 1.33322 \times 10^2$ Pa. In this instance, the vacuum degree of the vacuum absorption of the substrates by the upper and lower base plates 1,2 was below $0.1 \times 1.33322 \times 10^2$ Pa.

【0027】 Further, when the vacuum degree of the vacuum chamber 9 is less than $0.5 \times 1.33322 \times 10^2$ Pa, the vacuum absorption force of the upper substrate 3 to the upper base plate 1 becomes insufficient, or the absorption force of the lower substrate 4 to the lower base plate 2 via the elastic body 5 becomes insufficient to thereby result in the dropping of the upper substrate 3 or misalignment of the

substrates. In addition, when the vacuum degree in the vacuum chamber 9 exceeds 1.0 ×1.33322 ×10^2 Pa, air drops will remain in the fabricated liquid crystal panel. Also, when the vacuum degree of the vacuum absorption in the substrate formed by the upper and the lower base plate 1,2 exceeds 0.1 ×1.33322 ×10^2 Pa, the vacuum absorption force of the upper substrate 3 to the upper base plate 1 or the absorption force of the lower substrate 4 to the lower base plate 2 via the elastic body 5 becomes insufficient to thereby, as described above, result in the dropping of the upper substrate 3 or misalignment of the substrates. It is preferred that the vacuum absorption force of the substrates formed by the upper and lower base plates 1, 2 becomes closer to 0 Pa, and in principle it is best when the vacuum degree is 0 Pa, however, in actual there exists limitations in the possible vacuum degree due to design limitations of the pump operation part and the vacuum system, therefore, the critical vacuum degree in the present embodiment of the invention was 0.05×1.33322 ×10^2 Pa. Also, silicon rubber was utilized for the elastic body 5 in the present embodiment of the invention. As the porous elastic body may expand in openings, it cannot be employed. Further, materials having high elasticity coefficient (that is, solid materials) including a paper, are not preferred because the pressurization would be carried out unequally, so it is considered that materials having small elasticity coefficient are preferred as the elasticity body 5.

【0028】 With maintaining the vacuum chamber 9 at the vacuum degree explained above, position alignment of the upper and lower substrates 3, 4 are performed with proper intervals maintained between the substrates, and then the upper and lower substrates 3, 4 are stuck and the sealing resins are sufficiently pressed with the force of 1.5 tons via the upper and lower base plates. In this instance, it

is necessary to fix the upper and lower base plates 1,2 by vacuum absorption so that position alignment of the upper and lower substrates 3, 4 can be maintained, and also it is necessary to empty the absorption opening 51 formed at the elastic body 5, which is arranged between the lower substrate 4 and the lower base plate 2. The pitches of the absorption openings 51 formed at the elastic body 5, which were employed in assembling the fifth, sixth, and seventh pairs of color filter substrates, were respectively 10 ㎜, 6 ㎜, and 24 ㎜.

【0029】 Next, the fifth to seventh pairs of substrates which have been completed of sticking, are withdrawn from the substrate sticking apparatus, and then hardening of the sealing resins 6 are performed by radiation of the ultra violet rays, and the periphery portions of the substrates are cut to thereby fabricate the liquid crystal panel. Thus, when the liquid crystal materials 8 have been dropped as water drops before the sticking of the substrates, it is possible to abridge the processes of vacuum injection, and closing of the injection opening (sealing of the opening).

【0030】 Then, measurements of the cell gaps (100 points in the surface) of the first to seventh pairs of liquid crystal panels manufactured by the above stated process have been performed. Further, after mounting periphery circuits and displaying the panels, an estimation of the display uniformity is performed with naked eyes. The results obtained are represented in Table 1. The uniformity 3δ in the cell gaps represented in Table 1 is three times the standard deviation δ, supposing that the non-uniformity of the measured values is normal distribution in case of the cell gaps measurements.

【0031】

Assembling No. of pair of substrates	Pitch of the absorption opening in elastic body(㎜)	Machining process or not after sticking	Vacuum injection /opening closing process or not	Uniformity (3δ) Of the cell gaps(㎛)	Estimation of display uniformity with naked eyes
1	Elastic body none	Exist	Exist	0.21	○
2	10	None	Exist	0.26	Δ~○
3	6	None	Exist	0.21	○
4	24	None	Exist	0.20	○
5	10	None	None	0.28	○
6	6	None	None	0.20	○
7	24	None	None	0.22	○

○ : good

Δ : non-uniformity does not exist in displaying the identical intervals of the pitches

【0032】 As apparent from Table 1, in order to obtain identical degree of cell gap with the conventional manufacturing method for the first pair of substrates, as were the fourth and seventh pair of substrates, it is necessary for the pitch 52 of the absorption opening 51 formed at the elastic body 5, which is inserted between the lower substrate 4 and the lower base plate 4 to be n (n is integral number) times the pitch 22 of the absorption groove 21 of the lower base plate 2, and it is

necessary for the pitch 22 of the absorption opening 21 of the lower base plate 2 to be n (n is integral number) times the pitch 52 of the absorption opening 51 formed at the elastic body 5, that is, the pitch 52 of the absorption opening 51 formed at the elastic body 5 to be 1/n (n is integral number) times the pitch 22 of the absorption opening 21 of the lower base plate 2, as were the third and sixth pair of substrates.

【0033】 When the pitch 52 of the absorption opening 51 formed at the elastic body 5 and the pitch 22 of the absorption opening 21 of the lower base plate 2 do not meet the above explained relationship, display inequality of the pitches will arise depending on the least common multiple selected from the pitch 52 of the absorption opening 51 and the pitch 22 of the absorption groove 21 (second pair and fifth pair of substrates). This is because gap inequality will arise from the addition of the dynamic interference, which is produced from the position relationship between the absorption opening of the elastic body 5 and the absorption groove 21 of the lower base plate 2, to the load applied to the upper and lower substrates 3, 4 at the time of pressurizing of the substrate sticking. However, the uniformity of the cell gaps can be achieved by overcoming the interference based on the design explained above.

【0034】 As explained above, with regard to the substrate sticking process, the lower substrate 4 is absorbed to the lower base plate 2 via the elastic body 5 at which the absorption opening 51 is formed, the pitch 52 of the opening 51 being identical with n (n is integral number) times or 1/n (n is integral number) times the pitch 22 of the absorption groove 21 formed at the lower base plate 2, and performing position alignment of the upper and lower substrates 3, 4, and then the substrates are pressurized to be stuck by pressing the sealing resins 6 via the

upper and lower base plates 1, 2. Accordingly, although the planar machining degree of the upper and lower base plates 1, 2 is insufficient, since the upper and lower substrates 3, 4 can be stuck and pressurized simultaneously equally, it is not necessary to perform pressurizing process for press sealing resins required for the process following the conventional substrate sticking process to thereby achieve simplification of the manufacturing process, and to produce liquid crystal panel having uniform cell gaps.

【0035】 Further, as shown in FIG. 1 (c), when the absorption groove 21 formed at the lower base plate 2 has been arranged with the pitch 22 in the x direction (transversal direction), the absorption opening 52 of the elastic body 5 is arranged with the pitch 52 in the x direction (transversal direction), and the pitch 52 meets the relationship of n (n is integral number) times or 1/n times the pitch 22. In this case, although the pitch in the y direction (longitudinal direction) of the absorption opening 51 of the elastic body 5 may not be identical with the pitch 52 in the x direction, the absorption opening 51 is preferable to be arranged at equal pitch (equal intervals) in the y direction. In addition, it is possible to obtain the overlap between the absorption opening 51 of the elastic body 5 and the absorption groove 21 of the lower base plate 2 sufficiently by increasing the number of the absorption opening 51 in the elastic body 5 in practical, although the position of the absorption openings 51 are not particularly adjusted.

【0036】 Whereas, when the absorption opening is formed at the lower base plate 2, and not the absorption groove 21, the absorption opening is aligned and arranged at equal pitch (equal intervals) in the x and y directions respectively together with the absorption opening 51 of the elastic body 5. In such case, the pitch 52 in the x direction of the absorption opening 51 formed at the elastic body

5 meets the relationship of n (n is integral number) times or 1/n times the pitch of the absorption groove 21 of the lower base plate 2, and the pitch in the y direction of the absorption opening 51 formed at the elastic body 5 meets the relationship of n (n is integral number) times or 1/n times the pitch in the y direction of the absorption opening formed at the lower base plate 2. Also, in such a case, it is possible to obtain the overlap between the absorption opening 51 of the elastic body 5 and the absorption opening of the lower base plate 2 sufficiently by increasing the number of the absorption opening 51 in the elastic body 5 in practical, although the position of the absorption openings 51 is not particularly adjusted.

【0037】 Also, the absorption groove or absorption opening (not shown) should be formed at the absorption surface of the upper base plate 1 to absorb the upper substrate 3.

【0038】 As stated above, the substrate sticking apparatus shown in FIG. 1 comprises an upper base plate 1 and a lower base plate 2, each being provided with an absorption groove or an absorption opening at the absorption surface thereof. Also, in the above apparatus, it is possible to maintain a distance between the upper and lower substrates absorbed to the upper and lower base plates 1, 2 respectively to be constant to thereby align them. In addition, the upper and lower substrates 3, 4 may be constructed to be pressurized with interposing the upper and the lower base plates 1, 2, and simultaneously an elastic body 5 with an absorption opening 51 is arranged on a substrate absorption surface of the lower base plate 2. Further, a pitch of the absorption opening 51 formed at the elastic body 5 is made to meet the above stated relationship.

【0039】 In addition, the substrate sticking apparatus shown in FIG. 2 includes the substrate sticking apparatus shown in FIG. 1 in a chamber 9 wherein the inner pressure can be adjusted.

【0040】 Further, in the present embodiment of the invention, although the elastic body 5 has been constructed of a silicon rubber, however as the elastic body 5, for example, it can also be made of dual layer structure elastic body disclosed in Japanese Patent Laid-Open Publication No. Hei 11-264991 (Japanese Patent application No. Hei 10-136924), which consists of a soft portion and a hard portion. Then, as explained in the above embodiment of the present invention, the absorption opening 51 is formed at the elastic body 5 so that the hard portion thereof can be contacted with the lower substrate 4 to improve the uniformity of the cell gap in the panel surface.

【0041】 Also, as shown in FIGs. 1 and 2, in the embodiment of the present invention, although the present invention has been explained in connection with the spacer particles 7 to be applied on the upper substrate 3, the spacer particles 7 can also be applied on the lower substrate 4. Further, instead of applying the spacer particles 7, photo-sensitive resins can be applied to form protrusion pattern by applying photo lithography technology or protrusion may be formed by printing the resins, on any one substrate of the upper and lower substrates 3, 4.

【0042】 In addition, as shown in FIG. 1, although the sealing resins 6 have been formed on the lower substrate 4 to attach the upper and lower substrates 3, 4 and seal the liquid crystal, they can also be formed on the upper substrate 3 instead of forming them on the lower substrate 4. However, it is preferable to form the

sealing resins 6 on the lower substrate 4 at which the liquid crystal materials 8 have been dropped, in case of FIG. 2.

【0043】 Further, although the color filter substrate has been used as for the lower substrate 4 and the TFT array substrate 3 has been used as for the upper substrate 3 in the embodiment of the present invention, also the color filter substrate can be used as for the upper substrate 3 and the TFT array substrate 4 can be used for the lower substrate 4.

【0044】

【Effects of the Invention】

As described above, according to the present invention, with regard to the substrate sticking process, the lower substrate is absorbed to the lower base plate via the elastic body at which the absorption opening is formed, the pitch of the opening being identical with n (n is integral number) times or 1/n times the pitch of the absorption groove or absorption opening formed at the lower base plate, and performing position alignment of the upper and lower substrates, and then the substrates are pressurized to be stuck by pressing the sealing resins via the upper and lower base plates. Accordingly, although the planar machining degree of the upper and lower base plates is insufficient, since the upper and lower substrates can be stuck and pressurized simultaneously uniformly, it is not necessary to perform pressurizing process for press the sealing resins required for the process following the conventional substrate sticking process to thereby achieve the simplification of the manufacturing process, and to produce liquid crystal panels having uniform cell gaps.

【Description of Drawings】

FIG. 1(a) is a schematic cross-sectional view showing a substrate sticking process in a method for manufacturing a liquid crystal panel according to the first embodiment of the present invention;

FIG. 1(b) is a schematic planar view of an elastic body 5;

FIG. 1(c) is a schematic planar view of a lower base plate;

FIG. 2 is a schematic cross-sectional view showing a substrate sticking process in a method for manufacturing a liquid crystal panel according to the second embodiment of the present invention; and

FIG. 3is a conventional schematic cross-sectional view showing a substrate sticking process in a method for manufacturing a liquid crystal panel.

【Explanation of Numerals】

1: upper base plate 2: lower base plate

21: absorption groove formed at the lower base plate

22: pitch of the absorption groove in the lower base plate 3: upper substrate 4: lower substrate

5: elastic body 51: absorption opening of the elastic body

52: pitch of the absorption opening in the elastic body

7: spacer particle 8: liquid crystal materials

9: vacuum chamber

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-236292

(43)Date of publication of application : 23.08.2002

(51)Int.Cl. G02F 1/1339
G02F 1/13
G02F 1/1333

(21)Application number : 2001-033575

(22)Date of filing : 09.02.2001

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

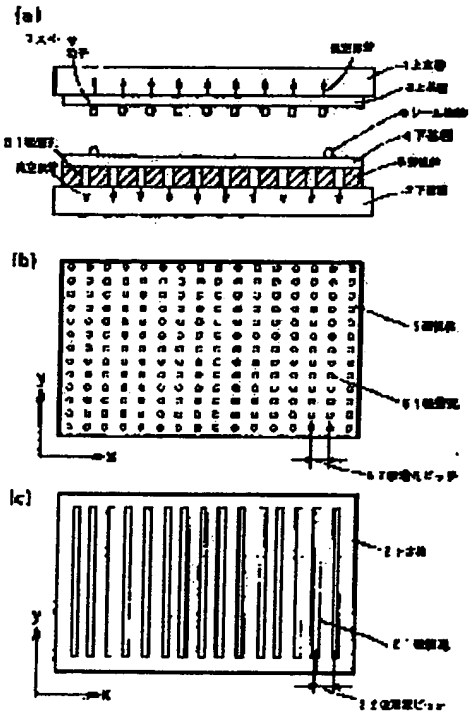
(72)Inventor : SUMIDA SHIROU
YAMADA SATOSHI
MATSUKAWA HIDEKI

(54) MANUFACTURING METHOD FOR LIQUID CRYSTAL PANEL AND SUBSTRATE STICKING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a manufacturing method for a liquid crystal panel, by which manufacturing stages can be simplified and to provide a substrate sticking device used for the method.

SOLUTION: In a substrate sticking stage, a lower substrate 4 is attracted to a lower surface plate 2 through an elastic body 5 in which attracting holes 51 are formed with a pitch 52 which is integral multiple of a pitch 22 of an attracting grooves 21 of the lower surface plate 2. After the positioning of an upper and a lower substrates 3 and 4 is performed, the substrates are stuck to each other by pressing the substrates through an upper surface plate 1 and the lower surface plate 2 to crush a sealing resin 6. Even if the surface working precision of the upper and the lower surface plates 1 and 2 is insufficient, sticking and uniform pressing of the upper and the lower substrates 3 and 4 can be simultaneously performed and a pressing stage for crushing the sealing resin, which has been conventionally needed after the substrate sticking stage, is not required and the manufacturing stages can be simplified.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2002－236292
（P2002－236292A）
(43)公開日　平成14年８月23日(2002.8.23)

(51)Int.Cl'		識別記号	FI			テーマコード'(参考)
G02F	1/1339	505	G02F	1/1339	505	2H088
	1/13	101		1/13	101	2H089
	1/1333	500		1/1333	500	2H090

審査請求　未請求　請求項の数５　ＯＬ　（全７頁）

(21)出願番号　特願2001－33575(P2001－33575)

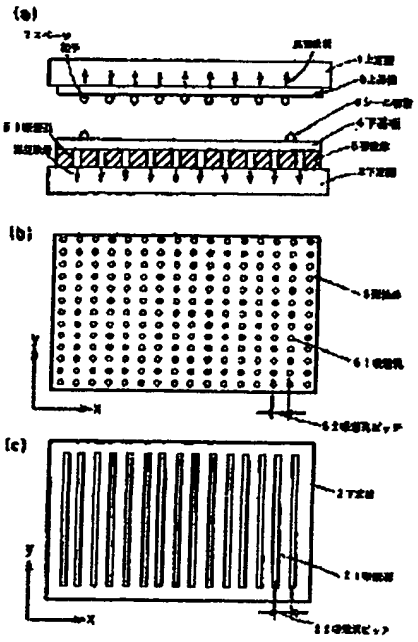
(22)出願日　平成13年２月９日(2001.2.9)

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地
(72)発明者　炭田　祉朗
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(72)発明者　山田　聡
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(74)代理人　100078174
弁理士　宮井　暎夫

最終頁に続く

(54)【発明の名称】　液晶パネルの製造方法および基板貼り合わせ装置

(57)【要約】
【課題】　従来．基板貼り合わせ工程では、上下定盤の平面加工精度が不十分であり、上下基板を均一に加圧してシール樹脂を押しつぶすために別途加圧工程が必要であった。
【解決手段】　基板貼り合わせ工程において、下定盤２に．下定盤２の吸着溝２１のピッチ２２の整数倍のピッチ５２で吸着孔５１が形成された弾性体５を介して下基板４を吸着し．上下基板３、４の位置合わせを行った後．上定盤１および下定盤２を介して加圧しシール樹脂６を押しつぶして貼り合わせる。上下定盤１，２の平面加工精度が不十分であっても、上下基板３，４を貼り合わせと同時に均一に加圧することができ、基板貼り合わせ工程の後で従来必要であったシール樹脂を押しつぶすための加圧工程を不要とし．製造工程の簡略化が図れる。



1

【特許請求の範囲】

【請求項１】　一対の基板のうちいずれかの基板に、前記一対の基板を接着しかつ液晶を封止するためのシール材料を塗布する工程と、

上側定盤および下側定盤を有する基板貼り合わせ装置を用い、前記一対の基板のうち一方の基板を、前記下側定盤の吸着溝または吸着孔が形成された吸着面に、吸着孔が形成された弾性体を介して真空吸着させ、他方の基板を前記上側定盤の吸着面に真空吸着させた状態で、前記一対の基板を対向させて位置合わせを行ない、前記上側定盤および下側定盤を介して前記一対の基板を加圧し前記シール材料を押しつぶして貼り合わせる基板貼り合わせ工程とを含み、

前記弾性体の吸着孔のピッチは、前記基板貼り合わせ工程において前記弾性体の吸着孔と前記下側定盤の吸着溝または吸着孔との互いの位置関係で生じる力学的干渉による前記一対の基板への加圧むらを抑制するように、前記下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の１倍となっていることを特徴とする液晶パネルの製造方法。

【請求項２】　一対の基板のうちいずれかの基板に、前記一対の基板を接着しかつ液晶を封止するためのシール材料を塗布する工程と、

前記一対の基板のうち一方の基板に所定量の液晶材料を滴下する工程と、

チャンバー内に上側定盤および下側定盤を有する基板貼り合わせ装置を用い、前記一対の基板のうち前記液晶材料を滴下した一方の基板を、前記下側定盤の吸着溝または吸着孔が形成された吸着面に、吸着孔が形成された弾性体を介して真空吸着させ、他方の基板を前記上側定盤の吸着面に真空吸着させるとともに、前記チャンバー内を前記基板の真空吸着よりも低い真空度に保持した状態で、前記一対の基板を対向させて位置合わせを行ない、前記上側定盤および下側定盤を介して前記一対の基板を加圧し前記シール材料を押しつぶして貼り合わせる基板貼り合わせ工程とを含み、

前記弾性体の吸着孔のピッチは、前記基板貼り合わせ工程において前記弾性体の吸着孔と前記下側定盤の吸着溝または吸着孔との互いの位置関係で生じる力学的干渉による前記一対の基板への加圧むらを抑制するように、前記下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の１倍となっていることを特徴とする液晶パネルの製造方法。

【請求項３】　基板貼り合わせ工程における上側定盤および下側定盤による基板の真空吸着の真空度を０．１×１．３３３２２×１０^4 Ｐａ以下とし、真空チャンバー内の真空度を０．５×１．３３３２２×１０^4 Ｐａ～１．０×１．３３３２２×１０^4 Ｐａとすることを特徴とする請求項２記載の液晶パネルの製造方法。

【請求項４】　それぞれ基板吸着面に吸着溝または吸着孔が形成された上側定盤および下側定盤を備え、前記上側定盤および下側定盤に吸着した一対の基板面を一定の距離に保持して位置合わせ可能で、かつ前記上側定盤および下側定盤を介して前記一対の基板を加圧可能な構成にするとともに、前記下側定盤の基板吸着面に吸着孔が形成された弾性体を設置し、前記弾性体の吸着孔のピッチは、前記下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の１倍であることを特徴とする基板貼り合わせ装置。

【請求項５】　内部圧力を調整可能なチャンバー内に、前記上側定盤および前記弾性体を設置した下側定盤を設けた請求項４記載の基板貼り合わせ装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、液晶パネルの製造方法およびそれに用いる基板貼り合わせ装置に関する。

【０００２】

【従来の技術】図３に従来の液晶パネルの製造方法における基板貼り合わせ工程の概略断面図を示す。図３に示すように、従来の液晶パネルでは、上下の定盤１，２に上下の基板３，４を直接真空吸着させ、上下基板３，４の位置合わせを行なった後に貼り合わせを行なっていた。

【０００３】

【発明が解決しようとする課題】液晶パネルに必要なセルギャップ精度は一般に、ＴＮパネルでは±０．３μｍ以下、ＳＴＮパネルでは±０．０５μｍ以下であるが、それに対して金属製の上下定盤１，２の平面加工精度は±２０μｍ程度しか期待できない。そのために、従来の基板貼り合わせ工程では上下基板３，４を均一に加圧する事が不可能であり、必要なセルギャップ精度を得るためには、上記の貼り合わせを行なった後に、別途準備した加圧機を用いて上下基板３，４を均一に加圧して、シール樹脂６を所定量だけ押しつぶす必要があった。このように従来、基板貼り合わせ工程の後、シール樹脂６を均一に押しつぶすために、別途加圧工程が必要であった。

【０００４】本発明の目的は、製造工程の簡略化を図ることができる液晶パネルの製造方法およびそれに用いる基板貼り合わせ装置を提供することである。

【０００５】

【課題を解決するための手段】請求項１記載の液晶パネルの製造方法は、一対の基板のうちいずれかの基板に、一対の基板を接着しかつ液晶を封止するためのシール材料を塗布する工程と、上側定盤および下側定盤を有する基板貼り合わせ装置を用い、一対の基板のうち一方の基板を、下側定盤の吸着溝または吸着孔が形成された吸着面に、吸着孔が形成された弾性体を介して真空吸着させ、他方の基板を上側定盤の吸着面に真空吸着させた状態で、一対の基板を対向させて位置合わせを行ない、上

2

側定盤および下側定盤を介して一対の基板を加圧しシール材料を押しつぶして貼り合わせる基板貼り合わせ工程とを含み、弾性体の吸着孔のピッチは、基板貼り合わせ工程において弾性体の吸着孔と下側定盤の吸着溝または吸着孔との互いの位置関係で生じる力学的干渉による一対の基板への加圧むらを抑制するように、下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の1倍となっていることを特徴とする。

【0006】この請求項1の製造方法によれば、基板貼り合わせ工程を、下側定盤に、吸着孔が形成された弾性体を介して基板を吸着し、位置合わせを行った後、一対の基板を加圧しシール材料を押しつぶして貼り合わせることにより、上側および下側定盤の平面加工精度が不十分であっても、一対の基板を貼り合わせと同時に均一に加圧することができ、基板貼り合わせ工程の後で従来必要であったシール材料を押しつぶすための加圧工程を不要とし、製造工程の簡略化を図ることができる。また、弾性体の吸着孔のピッチを、下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の1倍のピッチとしたことにより、弾性体の吸着孔と下側定盤の吸着溝または吸着孔との互いの位置関係で生じる力学的干渉による一対の基板への加圧むらが抑制され、セルギャップの均一な液晶パネルを生産することができる。

【0007】請求項2記載の液晶パネルの製造方法は、一対の基板のうちいずれかの基板に、一対の基板を接着しかつ液晶を封止するためのシール材料を塗布する工程と、一対の基板のうち一方の基板に所定量の液晶材料を滴下する工程と、チャンバー内に上側定盤および下側定盤を有する基板貼り合わせ装置を用い、一対の基板のうち液晶材料を滴下した一方の基板を、下側定盤の吸着溝または吸着孔が形成された吸着面に、吸着孔が形成された弾性体を介して真空吸着させ、他方の基板を上側定盤の吸着面に真空吸着させるとともに、チャンバー内を基板の真空吸着よりも低い真空度に保持した状態で、一対の基板を対向させて位置合わせを行ない、上側定盤および下側定盤を介して一対の基板を加圧しシール材料を押しつぶして貼り合わせる基板貼り合わせ工程とを含み、弾性体の吸着孔のピッチは、基板貼り合わせ工程において弾性体の吸着孔と下側定盤の吸着溝または吸着孔との互いの位置関係で生じる力学的干渉による一対の基板への加圧むらを抑制するように、下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の1倍となっていることを特徴とする。

【0008】この請求項2の製造方法によれば、基板貼り合わせ工程を、下側定盤に、吸着孔が形成された弾性体を介して基板を吸着し、位置合わせを行った後、一対の基板を加圧しシール材料を押しつぶして貼り合わせることにより、上側および下側定盤の平面加工精度が不十分であっても、一対の基板を貼り合わせと同時に均一に加圧することができ、基板貼り合わせ工程の後で従来必要であったシール材料を押しつぶすための加圧工程を不要とし、製造工程の簡略化を図ることができる。また、弾性体の吸着孔のピッチを、下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の1倍のピッチとしたことにより、弾性体の吸着孔と下側定盤の吸着溝または吸着孔との互いの位置関係で生じる力学的干渉による一対の基板への加圧むらが抑制され、セルギャップの均一な液晶パネルを生産することができる。

【0009】請求項3記載の液晶パネルの製造方法は、基板貼り合わせ工程における上側定盤および下側定盤による基板の真空吸着の真空度を0.1×1.33322×10² Pa以下とし、真空チャンバー内の真空度を0.5×1.33322×10² Pa～1.0×1.33322×10² Paとすることを特徴とする。このように真空度を設定することが好ましい。

【0010】請求項4記載の基板貼り合わせ装置は、それぞれ基板吸着面に吸着溝または吸着孔が形成された上側定盤および下側定盤を備え、上側定盤および下側定盤に吸着した一対の基板間を一定の距離に保持して位置合わせ可能で、かつ上側定盤および下側定盤を介して一対の基板を加圧可能な構成にするとともに、下側定盤の基板吸着面に吸着孔が形成された弾性体を設置し、弾性体の吸着孔のピッチは、下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の1倍であることを特徴とする。

【0011】この請求項4記載の基板貼り合わせ装置を用いて、請求項1における基板貼り合わせ工程を行うことができ、製造工程の簡略化を図ることができる。

【0012】請求項5記載の基板貼り合わせ装置は、請求項4記載の基板貼り合わせ装置において、内部圧力を調整可能なチャンバー内に、上側定盤および弾性体を設置した下側定盤を設けたものである。

【0013】この請求項5記載の基板貼り合わせ装置を用いて、請求項2，3における基板貼り合わせ工程を行うことができ、製造工程の簡略化を図ることができる。

【0014】

【発明の実施の形態】本発明の実施の形態について、図面を参照しながら説明する。図1は本発明の第1の液晶パネルの製造方法における基板貼り合わせ工程の概略図であり、図1（a）は断面図、図1（b）は弾性体5の平面図、図1（c）は下定盤2の平面図を示す。図2は本発明の第2の液晶パネルの製造方法における基板貼り合わせ工程を示す概略断面図である。図1は液晶の充填を真空注入法により行う場合であり、図2は液晶滴下法により行う場合である。

【0015】以下では、10.4インチアモルファスシリコンTFT液晶パネルを条件を変えて7組試作し、比較を行なった。

【0016】まず、大きさが300mm×400mmで10.4インチのパネルが2面パターンニングされたT

ＦＴアレイ基板とカラーフィルタ基板を７組準備し、それぞれの基板に、洗浄、ポリイミド製の配向膜の形成、硬化、所定のラビング処理を行なった。

【００１７】次にアレイ基板側に粒径４．５μｍの樹脂製スペーサ粒子７を１平方ミリメートル当たり１００～２００個の割合で散布し、カラーフィルタ側には、繊維径５．５μｍのガラス繊維を２．０％混入した紫外線硬化型のシール樹脂６を、スクリーン印刷法を用いてパターン形成した。この時、第１組から第４組のカラーフィルタ基板には注入口のあるパターンを、第５組から第７組のカラーフィルタ基板には注入口の無いパターンをそれぞれ形成した。

【００１８】これら７組のアレイ基板とカラーフィルタ基板を用いて、以下のように貼り合わせを行なった。

【００１９】まず、第１組は従来の製造方法を用いて貼り合わせを行なった。図３に示すように、カラーフィルタ基板を下基板４として下定盤２に、アレイ基板を上基板３として上定盤１に真空吸着して、上下基板３、４を一定の距離に保持して位置合わせ（アライメント）を行なった後に上下基板３，４を貼り合わせた。

【００２０】次に上記の貼り合わせ済み基板を、基板貼り合わせ装置から取り出し、真空パック（加圧工程）を施してシール樹脂６を押しつぶした後に、紫外線照射によるシール樹脂６の硬化を行なった。

【００２１】第２組から第４組は、図１（ａ）に示すように、基板貼り合わせ装置の下定盤２と下基板４間に弾性体５を挿入して貼り合わせを行なった。ここで、厚さが１．２ｍｍで、図１（ｂ）に示す吸着孔５１のピッチ５２が６ｍｍ、１０ｍｍ、２４ｍｍの、３通りのシリコンゴムからなる弾性体５を準備した。なお、ここで用いた基板貼り合わせ装置の下定盤２の吸着溝２１のピッチ２２は１２ｍｍであった。以下詳しく説明する。

【００２２】カラーフィルタ基板を下基板４として予め準備した弾性体５を介して下定盤（下側定盤）２に、アレイ基板を上基板３として上定盤（上側定盤）１にそれぞれ真空吸着して、上下基板３，４を一定の距離に保持して位置合わせ（アライメント）を行なった後に、上下基板３，４を貼り合わせ、上下定盤１、２を介して１．５トンで加圧してシール樹脂６を十分に押しつぶした。この時、上下基板３，４の位置合わせがずれないように、上下定盤１、２の真空吸着による固定が必要であり、そのために下基板４と下定盤２間に設置した弾性体５に吸着孔５１を空けておく必要がある。第２組、第３組、第４組の組立てに用いた弾性体５の吸着孔５１のピッチ５２はそれぞれ、１０ｍｍ、６ｍｍ、２４ｍｍであった。

【００２３】次に上記の貼り合わせ済み基板（第２組から第４組）を、基板貼り合わせ装置から取り出し、紫外線照射によるシール樹脂６の硬化を行なった。

【００２４】これら第１組から第４組の貼り合わせ済み

基板の周辺部分を切断した後、真空注入法を用いて液晶材料を充填し、注入口を封止して液晶パネルを作製した。

【００２５】また、第５組から第７組は、図２に示すように、予めカラーフィルタ基板に液晶材料８を滴下した後に、第２組から第４組と同様に、基板貼り合わせ装置の下定盤２と下基板４間に弾性体５を挿入して貼り合わせを行なった。以下、詳しく説明する。なお、図２における弾性体５、下定盤２の平面図は、図１（ｂ）、（ｃ）と同じである。

【００２６】予め液晶材料８を滴下したカラーフィルタ基板を下基板４として弾性体５を介して下定盤２に、アレイ基板を上基板３として上定盤１にそれぞれ真空吸着して、真空チャンバー９内の真空度が０．５×１．３３３２２×１０^{4} Ｐａ～１．０×１．３３３２２×１０^{4} Ｐａになるまで真空引きを行なった。この時、上下定盤１、２による基板の真空吸着の真空度は、０．１×１．３３３２２×１０^{4} Ｐａ以下であった。

【００２７】ここで、真空チャンバー９内の真空度が０．５×１．３３３２２×１０^{4} Ｐａ未満の場合には、上基板３と上定盤１との真空吸着力が不十分になったり、下基板４と弾性体５を介しての下定盤２との真空吸着力が不十分になったりして、上基板３の落下やアライメントずれが発生する。また、真空チャンバー９内の真空度が１．０×１．３３３２２×１０^{3} Ｐａを超えた場合には、作製された液晶パネル内に気泡が残ってしまう。また、上下定盤１，２による基板の真空吸着の真空度が０．１×１．３３３２２×１０^{3} Ｐａを超えると、上基板３と上定盤１との真空吸着力、または下基板４と弾性体５を介しての下定盤２との真空吸着力が不十分になり、前述同様、上基板３の落下やアライメントずれが発生する。この上下定盤１、２による基板の真空吸着の真空度は、０Ｐａに近い程好ましく、理論的には０Ｐａが最良であるが、実際は、ポンプ能力と真空系の設計により可能な真空度の限界があり、本実施の形態では、０．０５×１．３３３２２×１０^{4} Ｐａ程度が限界であった。また、本実施の形態では、弾性体５にシリコンゴムを用いているが、多孔質の弾性体では孔の影響があり、使用できない。また、柔らかい弾性率の高いもの（硬いもの）は加圧が不均一になり好ましくなく、弾性体５としては弾性率の小さいものほど好ましいと考えられる。

【００２８】前述した真空度で真空チャンバー９内を保持しながら、上下基板３、４を一定の距離に保持して位置合わせ（アライメント）を行なった後に、上下基板３、４を貼り合わせ、上下定盤１，２を介して１．５トンで加圧してシール樹脂６を十分に押しつぶした。この時、上下基板３、４の位置合わせがずれないように、上下定盤１，２の真空吸着による固定が必要であり、そのために下基板４と下定盤２間に設置した弾性体５に吸着孔５１を空けておく必要がある。第５組、第６組、第７

組の組立てに用いた弾性体5の吸着孔51のピッチ52はそれぞれ、10mm、6mm、24mmであった。

【0029】次に上記の貼り合わせ済み基板（第5組から第7組）を、基板貼り合わせ装置から取り出し、紫外線照射によるシール樹脂6の硬化を行ない、さらに、基板の周辺部分を切断して、液晶パネルを作製した。このように、基板貼り合わせ前に予め液晶材料8を滴下した場合には、真空注入、注入口の封止（封口）工程を省略する事ができる。

*【0030】以上のように作製した第1組から第7組の液晶パネルのセルギャップ測定（面内100点）を行なった。さらに周辺回路を実装し、パネル表示を行なって表示の均一性の目視評価を実施した。これらの結果を表1に示す。表1のセルギャップ均一性の3σは、上記セルギャップ測定における測定値のばらつきを正規分布と推定し、その標準偏差σの3倍値である。

【0031】

【表1】

組立て番号	弾性体の吸着孔ピッチ（mm）	貼り合わせ後加圧工程の有無	真空注入／封口工程の有無	セルギャップ均一性 3σ（μm）	表示均一性の目視評価
第1組（従来工法）	弾性体なし	有り	有り	0．21	○
第2組	10	無し	有り	0．26	△～○
第3組	6	無し	有り	0．21	○
第4組	24	無し	有り	0．20	○
第5組	10	無し	無し	0．28	△
第6組	6	無し	無し	0．20	○
第7組	24	無し	無し	0．22	○

［表示均一性の目視評価］

○ …良好

△ …60mmピッチの等間隔の表示むら有り

【0032】表1から明らかなように、第1組の従来工法と同等のセルギャップ精度を得るためには、第4組および第7組のように、下基板4と下定盤2間に挿入する弾性体5の吸着孔51のピッチ52が、下定盤2の吸着溝21のピッチ22の整数倍となっているか、第3組および第6組のように、下定盤2の吸着溝21のピッチ22が弾性体5の吸着孔51のピッチ52の整数倍、すなわち、弾性体5の吸着孔51のピッチ52が下定盤2の吸着溝21のピッチ22の整数分の1倍となっている事が必要である。

【0033】弾性体5の吸着孔ピッチ52と下定盤2の吸着溝ピッチ22が、上記の関係を満たしていない場合には、吸着孔ピッチ52と吸着溝ピッチ22の最小公倍数に対応したピッチの表示ムラが発生する（第2組，第5組）。これは、弾性体5の吸着孔51と下定盤2の吸着溝21との互いの位置関係で生じる力学的干渉が、基板貼り合わせの加圧時に上下基板3，4に付加される荷重に反映され、ギャップむらとなるからであって、上記のような設計にする事によって、干渉を回避する事ができ、セルギャップを均一にする事ができる。

【0034】以上のように、基板貼り合わせ工程において、下定盤2に、下定盤2の吸着溝21のピッチ22の整数倍または整数分の1倍（整数は1，2，3，・・・）のピッチ52で吸着孔51が形成された弾性体5を介して下基板4を吸着し、上下基板3，4の位置合わせを行った後、上定盤1および下定盤2を介して加圧しシール樹脂6を押しつぶして貼り合わせることにより、上下定盤1，2の平面加工精度が不十分であっても、上下基板3，4を貼り合わせと同時に均一に加圧することができ、基板貼り合わせ工程の後で従来必要であったシール樹脂を押しつぶすための加圧工程を不要とし、製造工程の簡略化を図ることができ、セルギャップの均一な液晶パネルを生産することができる。

【0035】なお、図1（c）のように下定盤2に吸着溝21がx方向（横方向）にピッチ22で配置されている場合、弾性体5の吸着孔51はx方向（横方向）にピッチ52で配置され、そのピッチ52がピッチ22の整数倍または整数分の1倍の関係を満たすようにする。この場合、弾性体5の吸着孔51のy方向（縦方向）のピッチは、x方向のピッチ52と同じでも異なってあって

もよいが、吸着孔５１はｙ方向にも等ピッチ（あるいは等間隔）で配置されているようにする。またこの場合、実際の運用では、弾性体５の吸着孔５１の数を多くすることにより、特に位置の調整をしなくても、弾性体５の吸着孔５１と下定盤２の吸着溝２１との重なりは十分に得られる。

【００３６】一方、下定盤２に、吸着溝２１ではなく吸着孔が設けられている場合、その吸着孔は、弾性体５の吸着孔５１のようにｘ方向、ｙ方向のそれぞれの方向について等ピッチ（あるいは等間隔）で整列して設けられる。この場合、弾性体５の吸着孔５１のｘ方向のピッチ５２が、下定盤２の吸着孔のｘ方向のピッチの整数倍または整数分の１倍の関係を満たし、かつ、弾性体５の吸着孔５１のｙ方向のピッチが、下定盤２の吸着孔のｙ方向のピッチの整数倍または整数分の１倍の関係を満たすようにする。またこの場合も、実際の運用では、弾性体５の吸着孔５１の数を多くすることにより、特に位置の調整をしなくても、弾性体５の吸着孔５１と下定盤２の吸着孔との重なりは十分に得られる。

【００３７】なお、上定盤１には、上基板３を吸着する面に、上基板３を吸着するための吸着溝または吸着孔（図示せず）が設けられている。

【００３８】図１の場合の基板貼り合わせ装置は、前述のようにそれぞれ基板吸着面に吸着溝または吸着孔が形成された上定盤１および下定盤２を備え、上定盤１および下定盤２に吸着した上下の基板３、４間を一定の距離に保持して位置合わせ可能で、かつ上定盤１および下定盤２を介して上下の基板３、４を加圧可能な構成であるとともに、下定盤２の基板吸着面に吸着孔５１が形成された弾性体５を設置し、弾性体５の吸着孔５１のピッチを前述の関係を満たすように設定したものである。

【００３９】また、図２の場合の基板貼り合わせ装置は、内部圧力を調整可能なチャンバー９内に、図１における基板貼り合わせ装置の構成を設けたものである。

【００４０】なお、本実施の形態では、弾性体５をシリコンゴムで構成したものとしたが、弾性体５として、例えば、特開平１１－２６４９９１号公報（特願平１０－１３６９２４号）にあるように、柔軟部と剛体部からなる２層構造のものを用い、それに本実施の形態のように吸着孔５１を設け、その柔軟部が下定盤２と接し、剛体部が下基板４と接するように設置することにより、パネル面内のセルギャップ均一性を更に向上することができる。

【００４１】また、本実施の形態では、図１，図２のように、セルギャップを規定するためのスペーサ粒子７を上基板３側に散布する場合について説明したが、上基板３側ではなく、下基板４側に散布するようにしてもよい。また、スペーサ粒子７を散布する代わりに、上基板３と下基板４のどちらか一方の基板に、感光性樹脂を塗布して突起のパターンをフォトリソグラフィ技術を適用して形成したり、あるいは樹脂を印刷して突起を設けてもよい。

【００４２】また、図１のように、上下基板３、４を接着しかつ液晶を封止するためのシール樹脂６を下基板４に形成したが、下基板４ではなく、上基板３に形成するようにしてもよい。しかしながら、図２の場合、液晶材料８を滴下する下基板４にシール樹脂６を形成しておいた方が好ましい。

【００４３】また、本実施の形態では、カラーフィルタ基板を下基板４とし、ＴＦＴアレイ基板を上基板３としたが、それとは逆に、カラーフィルタ基板を上基板３とし、ＴＦＴアレイ基板を下基板４としてもよい。

【００４４】

【発明の効果】以上のように本発明によれば、基板貼り合わせ工程において、下側定盤に、下側定盤の吸着溝または吸着孔のピッチの整数倍または整数分の１倍のピッチの吸着孔が形成された弾性体を介して基板を吸着し、一対の基板の位置合わせを行った後、上側定盤および下側定盤を介して一対の基板を加圧しシール材料を押しつぶして貼り合わせることにより、上側および下側定盤の平面加工精度が不十分であっても、一対の基板を貼り合わせと同時に均一に加圧することができ、基板貼り合わせ工程の後で従来必要であったシール材料を押しつぶすための加圧工程を不要とし、製造工程の簡略化を図ることができ、セルギャップの均一な液晶パネルを生産することができる。

【図面の簡単な説明】

【図１】（ａ）は本発明の第１の液晶パネルの製造方法における基板貼り合わせ工程を示す概略断面図、（ｂ）は弾性体の概略平面図、（ｃ）は下定盤の概略平面図

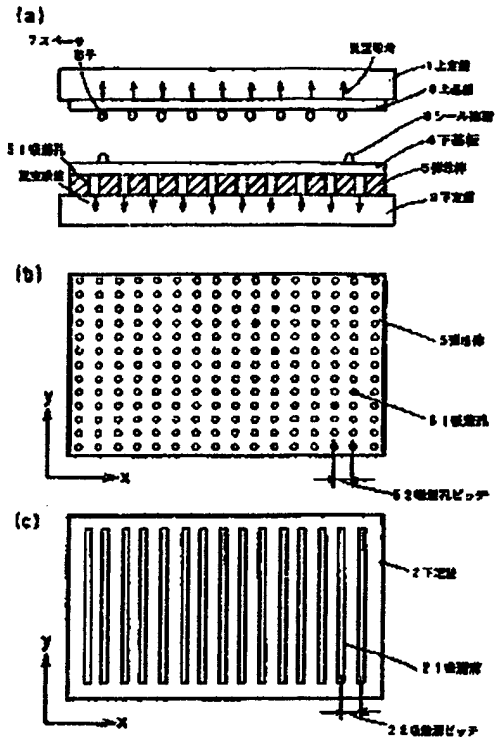
【図２】本発明の第２の液晶パネルの製造方法における基板貼り合わせ工程を示す概略断面図

【図３】従来の液晶パネルの製造方法における基板貼り合わせ工程を示す概略断面図

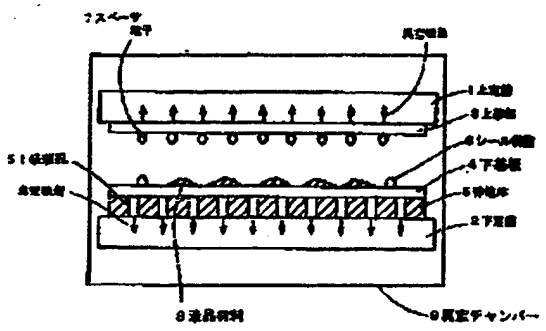
【符号の説明】

１　上定盤
２　下定盤
２１　下定盤の吸着溝
２２　下定盤の吸着溝のピッチ
３　上基板
４　下基板
５　弾性体
５１　弾性体の吸着孔
５２　弾性体の吸着孔のピッチ
６　シール樹脂
７　スペーサ粒子
８　液晶材料
９　真空チャンバー

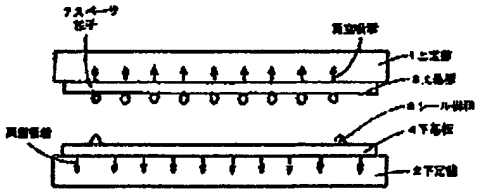
【図１】



【図２】



【図３】



フロントページの続き

(72)発明者　松川　秀樹
大阪府門真市大字門真1006番地　松下電器
産業株式会社内

Ｆターム(参考)　2H088 FA30 HA08 HA12 MA17
2H089 LA49 QA14 TA09 TA12
2H090 JC11 LA15